that Tanaka, teaches the use of intermittent control and response signals between a base station and terminals, with the Examiner further suggesting that Tanaka, provides a motivation for combining the teachings of the two references for the purpose of saving power.

The applicant would continue to contend that combining the references as suggested by the Examiner would be inappropriate. The Examiner has indicated that the test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference, nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the Examiner asserts the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. However the applicant would assert there must still be a possibility that the teachings can be combined, and that there be a motivation to do so.

In the present case, the motivation relied upon by the Examiner is a desire to reduce power consumption. While Tanaka does identify one of its objectives as being the reduction of power consumption, the suggestion refers to power consumption in the mobile unit, with one of the concerns of increased power consumption being the reduction in battery life in the mobile unit. However the applicant notes Tanaka is silent as to any motivation concerning power consumption in the base station, and therefore is not directly applicable to claim 1. Ironically the mobile units in the preferred embodiment of the present invention, associated with claim 4, neither intermittently transmit or receive pilot signals. Specifically we note the intermittently transmitted pilot signals from the multiple base stations form a nearly continuous signal stream received by the mobile unit. Therefore in the preferred embodiment, the power savings in the mobile unit would not be realized.

The Examiner is correct when he suggests that a proper test for obviousness is what the combined teachings would have suggested to one skilled in the art. However the applicant would assert, that one skilled in the art absent the teachings of the present invention would not have reached the same conclusion as the Examiner. We note one skilled in the art, traditionally views a pilot channel as being an unmodulated, direct-sequence spread spectrum signal transmitted continuously by each CDMA base station, (emphasis added) as evidenced by a CDMA glossary, available at the web site http://www.cdg.org/a_ross/DefNtoS.html, a copy of which is enclosed. It is noted that the definition expressly provides that the pilot signal be transmitted continuously. The express provision casts doubt as to whether an implied suggestion to the contrary would be sufficient to motivate one skilled in the art.

Furthermore the control signals in a TDMA communication format are not directly analogous to the pilot signals of a CDMA communication format, and

therefore the applicant would contend there is no implied motivation to combine the teachings of the two references. The applicant notes the pilot signal is one of several types of CDMA overhead channels, namely pilot, synch and paging channels, as identified in a description of the forward CDMA Channel, available at the web site http://www.cdg.org/a_ross/Forward.html, specifically pages 3 and 4 of the enclosed printed copy of the identified web site page.

The control channel used in TDMA communication systems has a purpose quite different from that of the pilot signal in CDMA communication systems. The TDMA control channel as illustrated in Tanaka, is used in the terminal stations to detect timing information to facilitate communication between the terminal stations and to receive control information from a base station. Specifically, Tanaka teaches in column 2, line 53, "Based on the timing of the downgoing CCH, a control signal and a response signal are intermittently transmitted between the mobile terminals 103 and 104 for handshake".

In contrast, the CDMA pilot signal is used to detect the base stations and the synchronization timing of a code used to spread the spectrum. A means corresponding to the control channel and related control signals in a TDMA communication system are provided in a CDMA communication system separate from the pilot signal. Specifically, the applicant notes on page 4 of the enclosed copy of the description of the forward CDMA channel, the traffic channels are described as being dynamically assigned. The mobile station is informed, via a paging channel message, which code channel it is to receive.

Whereas the mobile terminals in Tanaka receives the TDMA control signals from a single base station to determine the timing used to enable communication between the mobile terminals, in the present application the CDMA pilot signals are received by the mobile stations from a plurality of base stations for comparison of the relative amplitudes to identify handoff boundaries.

Furthermore, the TDMA control channel is received in a specific transmission slot, typically the first slot of a TDMA frame. In order to similarly offset the control channel signals from multiple base stations, similar to the teachings of the present invention, it would be required that additional time slots be allocated for the transmission of control signals in the TDMA system.

Therefore the applicant would assert, that one skilled in the art would not have been motivated to combine the teachings of the prior art system disclosed in the background portion of the specification and Tanaka, as suggested by the Examiner, for the purposes of making obvious the claimed invention.

As presently amended, claim 1 provides for a traffic channel transmit units which respectively transmit data signals in respective traffic channels, while a pilot channel transmit unit intermittently transmits a pilot signal, which allows a pilot signal to be intermittently transmitted at the same time data signals are

transmitted. These features are not similarly provided for or made obvious by either the prior art disclosed in the background portion of the specification or by Tanaka, taken separately or together. Similarly claim 4, which provides for data signals to be received, while pilot signals are received, claim 8, which provides for both the transmission and reception of the same, and claim 13, which provides for the reception of pilot signals which are respectively transmitted intermittently, are not disclosed or made obvious. Correspondingly claims 1, 4, 8 and 13 should be found to be allowable.

With respect to dependent claims 9-12, and 14-17, the applicant would assert the claims are similarly nonobvious and therefore allowable, as being dependent upon base claims which are nonobvious and allowable.

For the above noted reasons, the applicant would contend that it would not be appropriate to combine the teachings of the prior art system disclosed in the background portion of the specification and Tanaka, as suggested by the Examiner, and that the combined teachings of the cited references would not make known or obvious the claimed spread spectrum communication transmitter and receiver, and CDMA mobile communication system. The applicant would respectfully request that the Examiner reconsider the appropriateness of combining the cited references for the purpose of making obvious the present invention, and correspondingly reconsider the rejection of claims 1, 4 and 6-17. The applicant submits that the claims as presently amended are in a condition for allowance. Accordingly, reconsideration of the claims is earnestly requested.

Respectfully submitted,

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Date

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CDMA Glossary N-S

NAM
: See Number assignment module.

Neighbor Set
: The set of pilots associated with the CDMA Channels that are probable candidates for handoff. Normally the Neighbor Set consists of the pilots associated with CDMA Channels that cover geographical areas near the mobile station. See also Active Set, Candidate Set, and Remaining Set.

Network
: A network is a logical subset of the base stations in a cellular system, as identified by a SID. The network is identified by a unique (SID, NID) pair. A network can be as small or as large as needed, but must be totally contained within a single system.

Non-Autonomous Registration
: A registration method in which the base station initiates registration. See also Autonomous Registration.

Non-Slotted Mode
: An operation mode of the mobile station in which the mobile station continuously monitors the Paging Channel.

ns
: Nanosecond (10^{-9} second).

Null Traffic Channel Data
: One or more frames of 16 '1's followed bu eight '0's sent at the 1200 bps rate. Null traffic channel data is sent when no service option is active and no signaling message is being sent. Null traffic channel data serves to maintain the connectivity between the mobile station and the base station.

Number Assignment Module
: A set of MIN-related parameters stored in the mobile station. The NAM encapsulate the mobile station's network identity. Multiple NAMs are sometimes provided in a mobile stations so that, for example, the mobile can have local identities in adjoining service areas. Use of the NAM is not specified in IS-95, beyond identifying those semi-permanent station numeric indicators that should be stored in it [IS-95, Appendix F].

OLC
: See Overload class.

Ordered Registration
: A registration method in which the base station orders the mobile station to send registration related parameters.

Overhead Message

A message sent by the base station on the Paging Channel to communicate base-station-specific and system-wide information to mobile stations.

Overload Class (OLC)
: The means used to control system access by mobile stations, typically in emergency or other overloaded conditions. Mobile stations are assigned one (or more) of sixteen overload classes. Access to the CDMA system can then be controlled on a per class basis by persistence values transmitted by the base station.

Overload Control
: A means to restrict reverse analog control channel accesses by mobile stations. Mobile stations are assigned one (or more) of sixteen control levels. Access is selectively restricted by a base station setting one or more OLC bits in the Overload Control Global Action Message.

Paging
: The act of seeking a mobile station in order to deliver an incoming call.

Paging Channel
: A forward communication channel used by a base station to communication to a mobile station when it is not assigned to a traffic channel.

Parameter-Change Registration
: A registration method in which the mobile station registers when certain of its stored parameters change.

Parity Check Bits
: Bits added to a sequence of information bits to provide error detection, correction, or both.

Persistence
: A probability measure used by the mobile station to determine if it should transmit in a given Access Channel Slot.

Physical Layer
: The part of the communication protocol between the mobile station and thebase station that is responsible for the transmission and reception of data. The physical layer in the transmitting station is presented a frame by the multiplex sublayer and transforms it into an over-the-air waveform. The physical layer in the receiving station transforms the waveform back into a frame and presents it to the multiplex sublayer above it.

Pilot Channel
: An unmodulated, direct-sequence spread spectrum signal transmitted continuously by each CDMA base station. The Pilot Channel allows a mobile station to acquire the timing of the Forward CDMA Channel, provides a phase reference for coherent demodulation, and provides a means for signal strength comparisons between base stations for determining when to handoff.

Pilot PN Sequence
: A pair of modified maximal length PN sequences with period 2^{15} used to spread the Forward CDMA Channel and the Reverse CDMA Channel. Different base stations are identified by different pilot PN sequence offsets.

Pilot PN Sequence Offset Index
: The PN offset in units of 64 PN chips of a pilot, relative to the zero offset pilot PN sequence.

Pilot Strength
: The ratio of received pilot energy to overall received energy. See also E_c/I_0.

PN Sequence.

Pseudonoise sequence. A periodic binary sequence approximating, in some sense, a Bernoulli (coin tossing) process with equiprobable outcomes.

Point to Point Propagation Model

A propagation model in which median transmission loss calculations are based on specific characteristics and terrain profile of the path along the great circle between the transmitter and receiver.

Poisson Blocking Model

Also called
Lost
Calls
He
or
Mol
model. A mathematical model of telephone traffic blocking in which blocked calls persist for their normal holding time, even though unserviced. It is similar to the <u>Erlang C</u> blocking model, with which it is sometimes confused. The Poisson blocking probability for N resources, calling intensity y Erlangs, is

Power Control Bit

A bit sent in every 1.25 ms interval on the Forward Traffic Channel to signal the mobile station to increase or decrease its transmit power.

Power Control Group

A 1.25 ms interval on the Forward Traffic Channel and the Reverse Traffic Channel. See also Power Control Bit.

Power-Down Registration

An autonomous registration method in which the mobile station registers on power-down.

Power-Up Registration

An autonomous registration method in which the mobile station registers on power-up.

Privacy

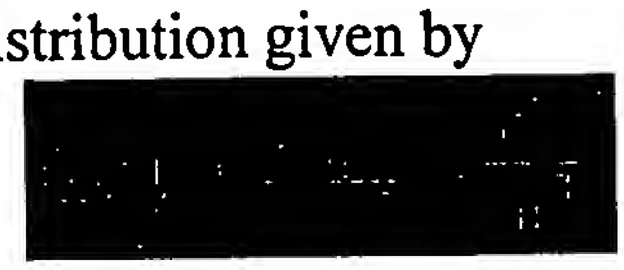
Protection of traffic by means of encryption or other means specifically applied for that purpose.

Propagation Loss

The total reduction in radiant power density between the transmitting antenna and the receiving antenna. Propagation loss includes both spreading (free space diffraction) loss and attenuation loss. For non-line of sight situations it also includes diffraction loss around obstacles. It does not include antenna gain or feeder loss. Sometimes called
i
propagation loss.

Rayleigh Distribution

The single-parameter probability distribution given by



or the equivalent density

[redacted]

Rayleigh Fading

The deep fading process characteristic of narrowband radio signals in a severe multipath propagation environment. The probability distribution of complex amplitude tends toward a bandlimited Gaussian, which has a Rayleigh distribution of amplitude. Cf. Flat Fading, Frequency Selective Fading, Ricean Fading.

Receive Objective Loudness Rating (ROLR)

A perceptually weighted transducer gain of telephone receivers relating electrical excitation from a reference generator to sound pressure at the earphone. The receive objective loudness rating is normally specified in dB relative to one Pascal per millivolt. See IEEE Standard 269-1992, IEEE Standard 661-1979, ITU-T Recommendations P.76 and P.79.

Registration

The process by which a mobile station makes its presence known to a base station to facilitate call delivery.

Registration Zone

A collection of one or more base stations treated as a unit when determining whether a mobile station should perform zone-based registration.

Release

A process that the mobile station and base station use to inform each other of call disconnect.

Reverse CDMA Channel

The CDMA Channel from the mobile station to the base station. From the base station's perspective, the Reverse CDMA Channel is the sum of all mobile station transmissions on a CDMA frequency assignment.

Reverse Traffic Channel

A Reverse CDMA Channel used to transport user and signaling traffic from a single mobile station to one or more base stations.

Rice (or Rician) Distribution

The probability distribution of the amplitude of a signal composed of a steady component plus independent IID quadrature Gaussian processes. It is applicable when a signal arrives at a receiver by both a line of sight path and by multiple indirect paths. This two-parameter distribution can be represented as

[redacted]

where
I

is the modified Bessel function of the first kind and order zero and a is the amplitude of the steady component. Note that this reduces to a Rayleigh distribution for $a = 0$.

Rician Fading

The fading process characteristic of radio signals when there is a strong line-of-sight signal path and multiple non-direct signal paths. The probability distribution of complex amplitude tends toward a bandlimited Gaussian with a nonzero mean, which has a Rician distribution of amplitude. Cf. Rayleign Fading, Flat Fading, Frequency Selective Fading.

http://www.cdg.org/a_ross/DefNtoS.html

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Roamer
A mobile station that is operating in a cellular system other than its home system.

ROLR
See Receive Objective Loudness Rating.

Sector
Normally one angular segment of the coverage area of a cell, served by one base station. Also used to denote any non-traditional partitioning of the service area, such one strand of a cable-based delivery system.

Service Option
A specific type of user traffic supported by a cellular system. The major service options are speech codecs, facsimile, and various types of data. Service options may be negotiated between base and mobile stations during call setup.

Serving MSC
The MSC which currently has the mobile station obtaining service at one of its cell sites within its coverage area.

Shared Secret Data (SSD)
A bit pattern stored in the mobile station and known by the base station. SSD is used to support the authentication procedures and voice privacy. Shared Secret Data is maintained during power off.

Signal-to-Noise Ratio (SNR)
The dimensionless ratio $E_b/(N_0+I_0)$, or energy per bit divided by the noise-plus-interference power spectral density. It is usually stated in dB.

Signaling
The information exchanged between the mobile station and the network, or within the network, for the purposes of service provision (e.g., connection establishment).

Slot Cycle
A periodic interval at which a mobile station operating in the slotted mode monitors the Paging Channel.

Slotted Mode
An operation mode of the mobile station in which the mobile station monitors only selected time slots on the Paging Channel when in the Mobile Station Idle State. The primary purpose of slotted mode is power conservation.

SNR
See Signal to Noise Ratio.

Soft Handoff
A handoff occurring while the mobile station is in the Mobile Station Control on the Traffic Channel State. This handoff is characterized by commencing communications with a new base station on the same CDMA frequency assignment before terminating communications with the old base station. Cf. Hard Handoff.

Symbol
See Code Symbol.

System Identification (SID)
A number uniquely identifying a cellular system.

| A-F | G-M | N-S | T-Z |

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Forward CDMA Channel

The FORWARD CDMA CHANNEL is the cell-to-mobile direction of communication. It carries traffic, a pilot signal, and overhead information. The pilot is a spread, but otherwise unmodulated DSSS signal. The pilot and overhead channels establish the system timing and station identity. The pilot channel also is used in the mobile-assisted handoff (MAHO) process as a signal strength reference.

Frequency Plan

The base station transmit frequency is 45 MHz above the mobile station transmit frequency in the cellular service (IS-95A), and 80 MHz above in the PCS service (ANSI J-STD-008). Permissible frequency assignments are on 30 kHz increments in cellular and 50 kHz in PCS. See Frequency Plans for further details.

Transmission Parameters

The IS-95A forward link currently supports a 9600 bps rate family in the three data-bearing channel types, as shown in the table. In all cases the FEC code rate is 1/2 and the PN rate is 1.2288 MHz. Note that 1.2288 MHz = 128*9600 bps.

Forward Link Channel Parameters, Rate Set 1

Channel	Sync	Paging		Traffic				
Data rate	1200	4800	9600	1200	2400	4800	9600	bps
Code repetition	2	2	1	8	4	2	1	
Modulation symbol rate	4800	19,200	19,200	19,200	19,200	19,200	19,200	sps
PN chips/modulation symbol	256	64	64	64	64	64	64	
PN chips/bit	1024	256	128	1024	512	256	128	

J-STD-008 supports, in addition to the above rates, a second traffic channel rate family with a maximum rate of 14,400 bps. This is termed Rate Set 2, the original 9600 bps family being Rate Set 1. Rate Set 2 uses an FEC code rate of 3/4, created by puncturing the code used in Rate Set 1.

Forward Link Channel Parameters, Rate Set 2

Channel	Traffic				
Data rate	1800	3600	7200	14400	bps
Code repetition	8	4	2	1	
Modulation symbol rate	19,200	19,200	19,200	19,200	sps
PN chips/modulation symbol	64	64	64	64	
PN chips/bit	682.67	341.33	170.67	85.33	

Signal Structure

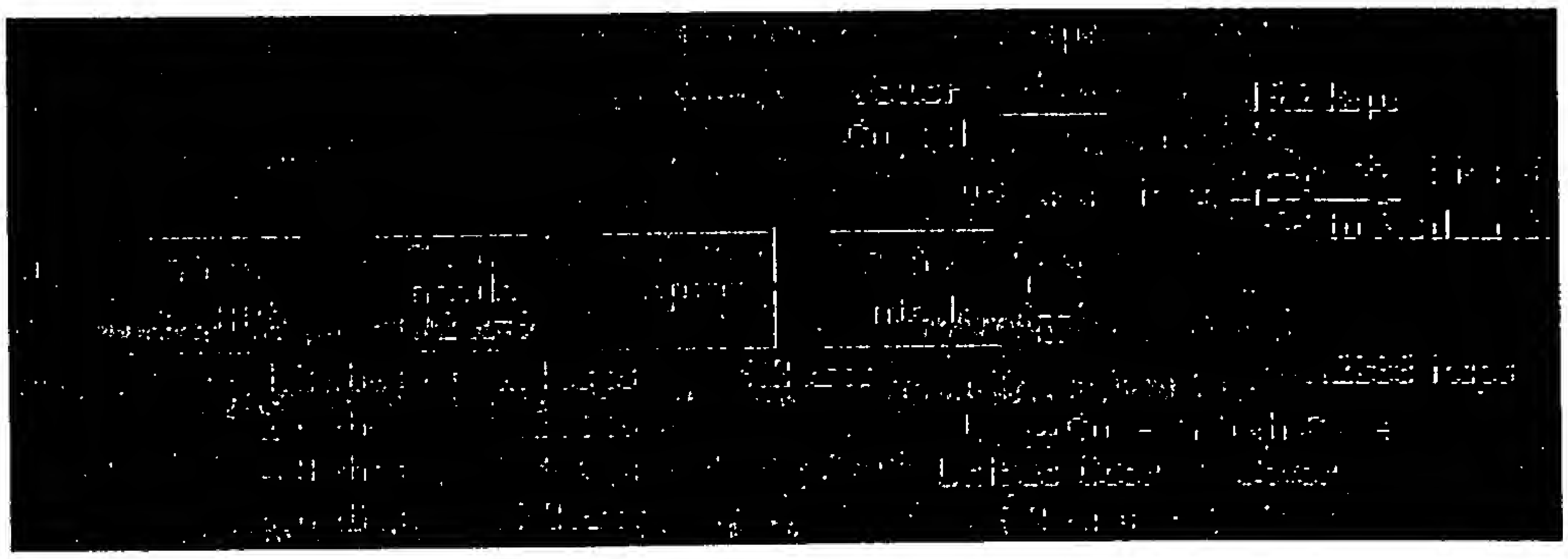
Channelization

The forward link consists of up to 64 logical channels (code channels). The channels are independent

in that they carry different data streams, possibly at different rates, and are independently adjustable in amplitude (Cf. Reverse Channelization).

Coding and Interleaving

The figure shows the core processing that generates one forward code channel, rate set 1. Rate set 2 is identical except the coding rate is 3/4 rather than 1/2, yielding the same code symbol rate with 3/2 times the data rate.



Walsh Codes

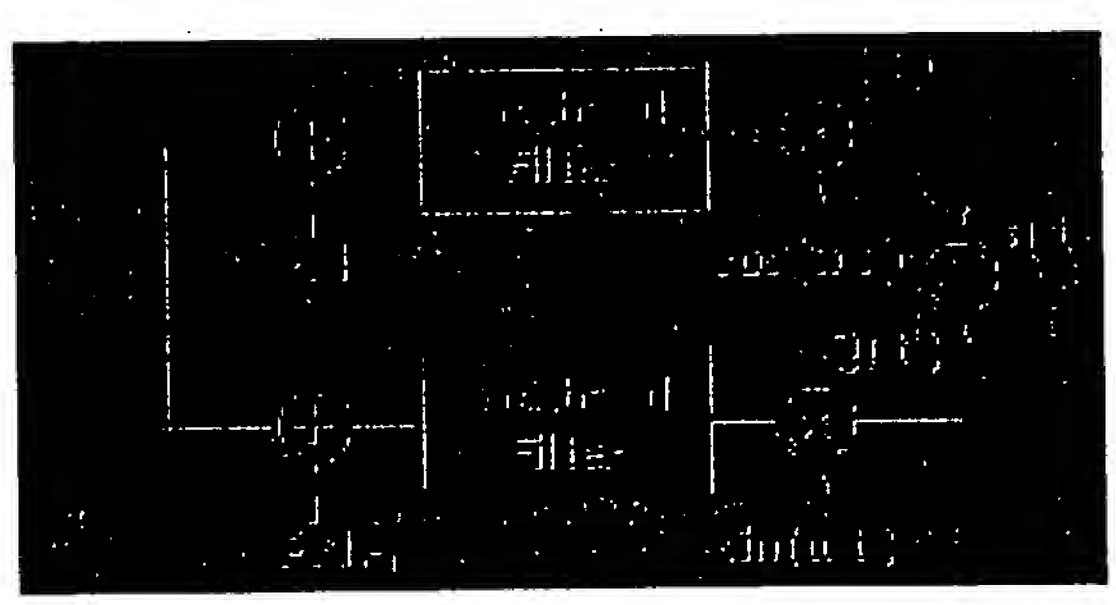
The code channels, as transmitted, are mathematically orthogonal. The orthogonality is established by covering the FEC code symbols with one of a set of 64 so-called Walsh functions. "Mutually orthogonal" means that their cross correlations are small (ideally zero). Because only whole periods of the Walsh functions occur in each code symbol, the effect of the Walsh cover is to make the channels completely separable in the receiver, at least in the absence of multipath. The orthogonality not only means that there is no co-mingling of channels, it means there is no interference between users in the same cell, again in the absence of multipath. This has a substantial beneficial effect on the forward link capacity.

Multipath delay spread that exceeds a chip does introduce mutual interference between users in one cell. In any particular Rake finger the uncorrelated channels contribute an effective interference level. This level varies from zero, when there is only one multipath component, up to (N-1)/N of the total signal power if there are N discrete, equal-amplitude multipath components.

Note that one of the Walsh functions is always a constant, code number zero, by the numbering convention. This channel is always reserved to serve as the pilot.

Spreading

Each forward code channel is spread by the Short Code, which has I- and Q-components. The spreading is thus quadrature. That is, from a single binary-valued, covered, symbol stream, two binary sequences are generated by mod 2 addition of the short code PN sequences, as shown in the figure.



Modulation

The two coded, covered, and spread streams are vector-modulated on the RF carrier. The spreading modulation is thus QPSK, superimposed on a BPSK code symbol stream.

The spectrum shaping of the forward link is carefully prescribed in the IS-95A air interface and the IS-97 performance specification. The latter is in terms of the so-called Rho meter, a measurement of the correlation between the actual transmitter output with the ideal transmitter output. The air interface also specifies a slightly nonlinear phase characteristic the purpose of which is partial pre-equalization of the mobile receiver.

In-band ripple is specified as less than ±1.5 dB. Stopband rejection is 40 dB beginning 740 kHz from band center. An equi-ripple, 48 tap FIR baseband filter is suggested, although not required.

Overhead channels

There are three types of overhead channel in the forward link: pilot, sync, and paging. The pilot is required in every station.

Pilot Channel

The pilot channel is always code channel zero. It is both a demodulation reference for the mobile receivers, and for handoff level measurements, and thus must be present in every station. It carries no information. It is pure short code, with no additional cover or information content.

The amplitude of the pilot and its spatial distribution must be carefully controlled because their relative amplitudes control handoff boundaries between stations. The PN_I and PN_Q modified linear feedback shift register sequences that comprise the short code have period 2^{15} chips, which is 80/3 = 26.667 ms at the 1.2288 MHz chip rate.

All stations use the same short code, and thus have the same pilot waveform. They are distinguished from one another only by the phase of the pilot. The short period of the short code, 2^{15}, facilitates rapid pilot searches by the mobiles.

The air interfaces stipulate that pilot phases always be assigned to stations in multiples of 64 chips, giving a total of $2^{15-6} = 512$ possible assignments. The 9-bit number that identifies the pilot phase assignment is called the
Pilot
Offset JQC Print function for our browser has trouble with italics

Sync Channel

The sync channel carries a repeating message that identifies the station, and the absolute phase of the pilot sequence. The data rate is always 1200 bps. The interleaver period is 80/3 = 26.667 ms, equal to the period of the short code. This simplifies finding frame boundaries, once the mobile has located the pilot.

The Sync Channel carries a single, repeating message that conveys the timing and system configuration information to the mobile station. The mobile station can derive accurate system time, to within a fraction of a spreading chip (833 ns) by synchronizing to the short code. The short code synchronization and the pilot offset, which is part of the sync message, fix system time modulo 26.667 ms. The code period ambiguity is then resolved by the long code state and system time fields that are also part of the sync message.

Paging Channel

The paging channel is the vehicle for communicating with mobile stations when they are not assigned to a traffic channel. As the name implies, its primary purpose is to convey pages, that is, notifications of incoming calls, to the mobile stations. It carries the responses to mobile station accesses, both page responses and unsolicited originations. Successful accesses are normally followed by an assignment to a dedicated traffic channel. Once on a traffic channel, signaling traffic between base and mobile can continued interspersed with the user traffic.

The paging channel may run at either 4800 or 9600 bps.

Each base station must have at least one paging channel per sector, on at least one of the frequencies in use. All paging can be done on one frequency, or it can be distributed over multiple frequencies.

Traffic Channel

Traffic channels are assigned dynamically, in response to mobile station accesses, to specific mobile stations. The mobile station is informed, via a paging channel message, which code channel it is to receive (it is tempting, but inappropriate to use the word "tune"!).

The traffic channel always carries data in 20 ms frames. Frames at the higher rates of Rate Set 1, and in all frames of Rate Set 2, include CRC codes to help assess the frame quality in the receiver.

Soft Handoff

During soft handoffs each base station participating in the handoff transmits the same traffic over its assigned code channel. The code channel assignments are independent, and in general will be different in each cell. Whatever code channels are not in use for overhead channels are available, up to either a total of 64 or the available equipment limit, whichever is smaller.

Rate

Traffic channels carry variable rate traffic frames, either 1, 1/2, 1/4, or 1/8 of the maximum rate. In IS-95A only a 9600 bps rate family is currently available in the standard. In J-STD-008 a second rate set, based on a maximum rate of 14,400 bps is available. The Rate Set 2 will be added in a future revision of IS-95.

The rate variation is accomplished by 1, 2, 4, or 8-way repetition of code symbols. Transmission is continuous, with the amplitude reduced at the lower rates so as to keep the energy per bit approximately constant, regardless of rate. The rate is independently variable in each 20 ms frame.

Power Control Subchannel

The 800 bps reverse link power control subchannel is carried on the traffic channel by puncturing 2 from every 24 symbols transmitted. The punctured symbols both carry the same power control bit, so they can be coherently combined by the receiver. Each base station participating in a soft handoff makes its own power control decision, independent of the others, unless they are different sectors of the same cell, in which case they all transmit a common decision. This special circumstance is made known to the mobile when the handoff is set up.

Timing

All base stations must be synchronized within a few microseconds for the station identification

mechanisms to work reliably and without ambiguity. Any convenient mechanism can be used for this purpose, but the system was designed under the assumption that the Global Positioning System (GPS) would be used. This is a family of low-earth-orbit satellites that broadcast a spread-spectrum signal and ephemeris information from which a sophisticated Kalman filter algorithm in a receiver can derive both a very accurate position and a very accurate time.
